

7.2 RESULTS OF SENSITIVITY ANALYSIS

Sensitivity of model output by varying key input parameters (see list above) is quantified by calculating the bias and mean square error of the simulated water levels versus observed water levels at selected model nodal locations. For each parameter, series of model runs were completed to determine a range of acceptable values such that each parameter value within the range can be used without significantly affecting the calibration. The results are grouped by magnitude of errors (expressed in terms of bias): 5th percentile, lower quartile, median, upper quartiles and 95th percentile. By using this method of analysis, one is able to determine whether the variation of a parameter affects all monitoring points or just a subset of monitoring points. For example, with respect to roughness coefficient, the simulated stages in the Everglades National Park appear to be more sensitive than the rest of the model domain, i.e., compared to Service Areas 1, 2 and 3, and the Water Conservation Areas. A ± 50 percent variation of the calibration value is recommended (Trimble, 1995a). The sensitivities of simulated stages at selected monitoring points as a function of input parameters are discussed in Section V in Trimble (1995a).

Figs. 7.2.1 through 7.2.5 show the components of the sensitivity matrix for stages at different monitoring points for different regions (LECSAs 1, 2 and 3, WCA and ENP) within the model domain. In order to generate these plots, the following substitutions were made in Eq. (7.1.1):

$$y_j^c = O_{95} \quad (7.2.1)$$

= output variable when input parameter is set at 95 percent confidence value

$$y_j^o = O_{\text{calibrated}} \quad (7.2.2)$$

= output variable when input parameter is set at the calibrated value

$$\Delta x_i = P_{95} - P_{\text{calibrated}} \quad (7.2.3)$$

where:

P_{95} = parameter value at the 95 percent confidence value of the parameter likelihood distribution; and

$P_{\text{calibrated}}$ = input parameter at the calibrated value.

The response of the output variables corresponds to the normalized values (change in stage expressed in terms of feet increase or decrease) based on a 100% change in parameter value (double and half). The range of simulated stages shown in Figs. 7.2.1 through 7.2.5 is the systems response (increase or decrease in simulated stage) if we double or halve seven parameter values at various locations within the system. The following general statements can be made regarding Figs. 7.2.1 through 7.2.5:

1. The computed stages for LECSA1 are generally most sensitive to coastal PET. Levee seepage and coastal PET affects the simulated stages in the West Palm Beach Catchment Area very significantly.
2. Similar to the previous LEC Service Areas, simulated stages in LECSA3 display a strong

sensitivity to coastal PET, although groundwater hydraulic conductivity dominates the sensitivities at gages G3253 (x,y: 29,25) or G3259A (x,y: 29,25).

3. The sensitivity of simulated water levels in the Water Conservation Areas and Everglades National Park is dominated by wetland PET. Surface roughness coefficient plays a vital role in model output sensitivity in the park while groundwater hydraulic conductivity and levee seepage are major parameters influencing the sensitivity in the WCAs.

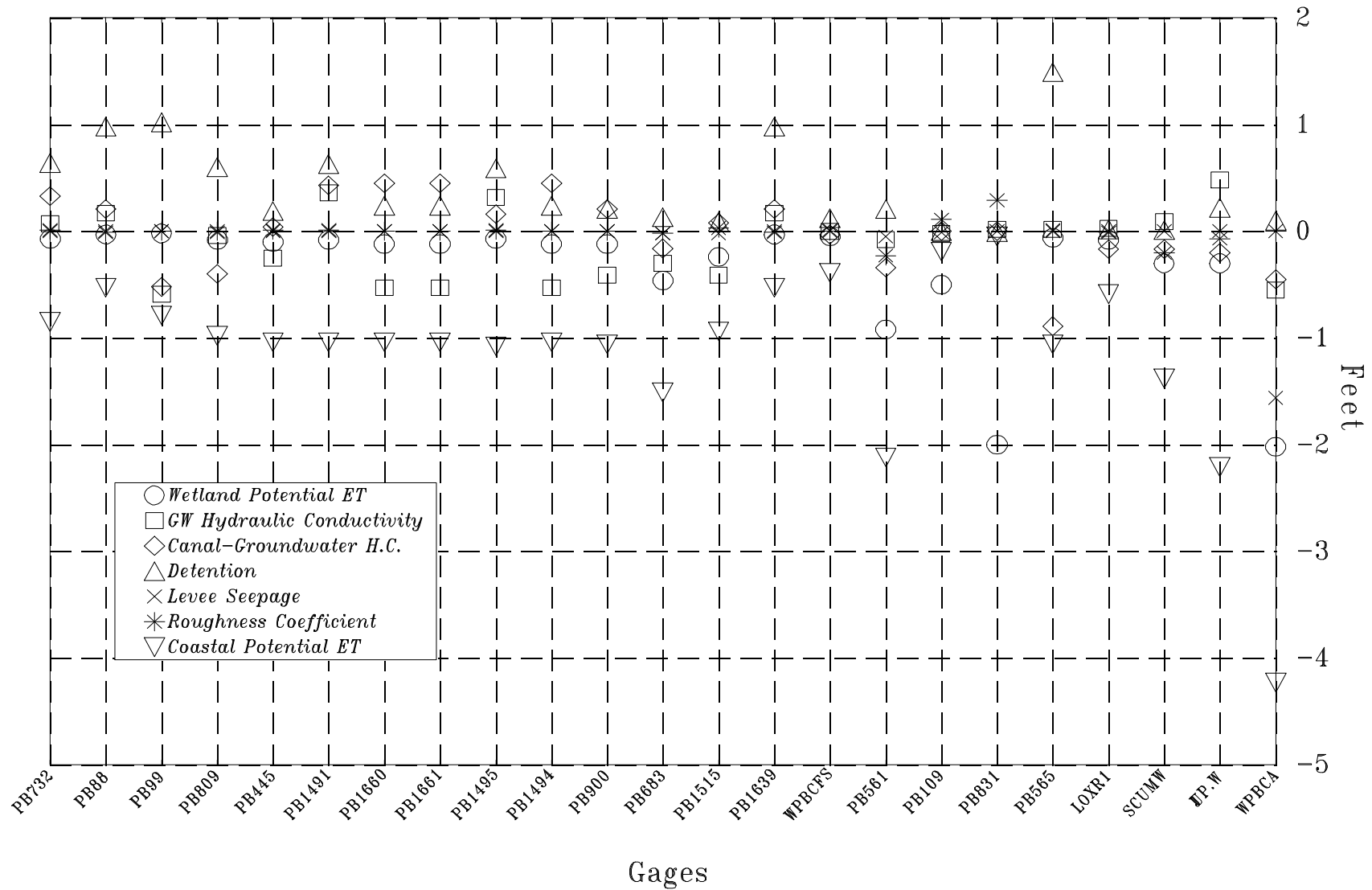


Figure 7.2.1 Components of the Sensitivity Matrix for Lower East Coast Service Area 1

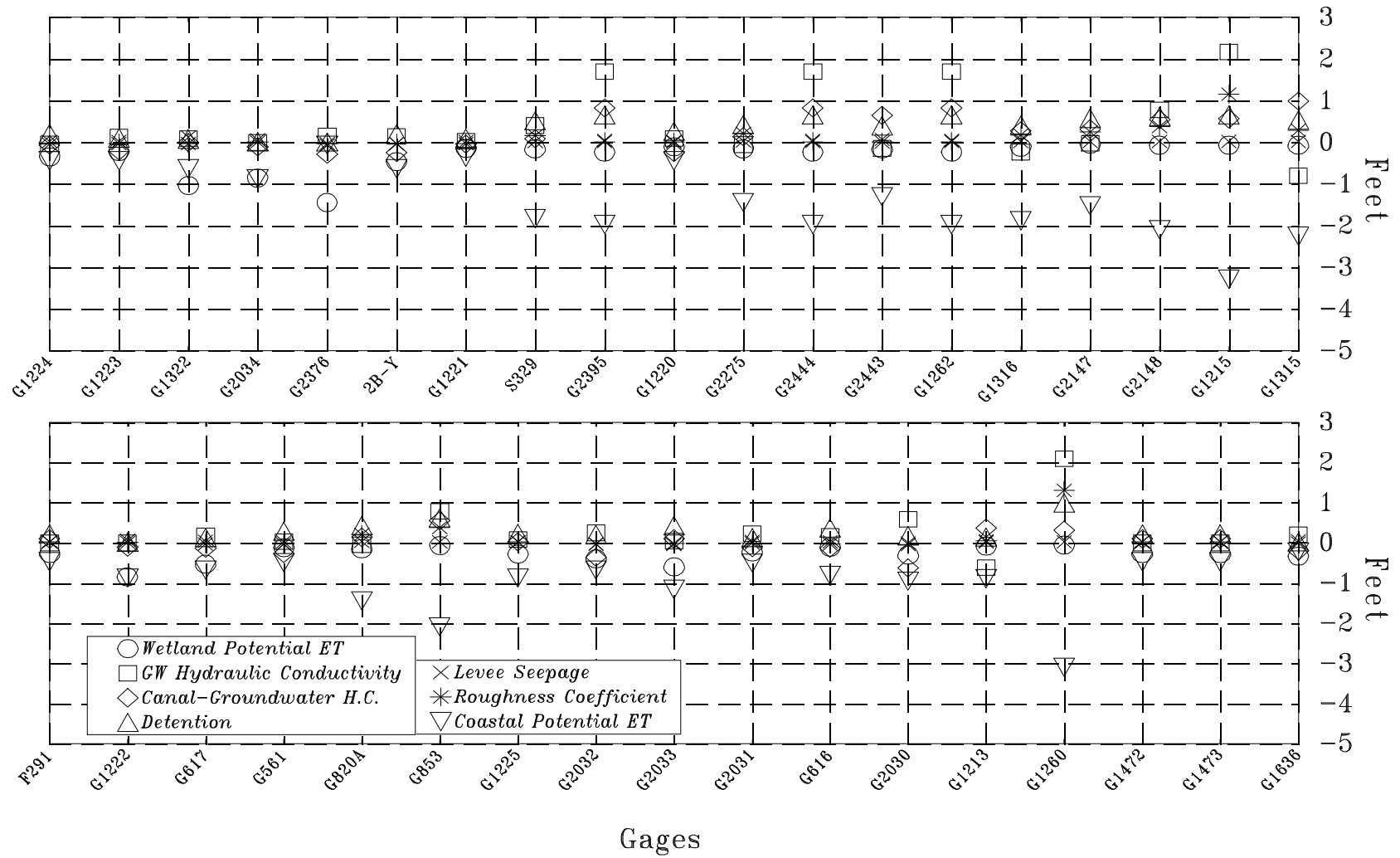


Figure 7.2.2 Components of the Sensitivity Matrix for Lower East Coast Service Area 2

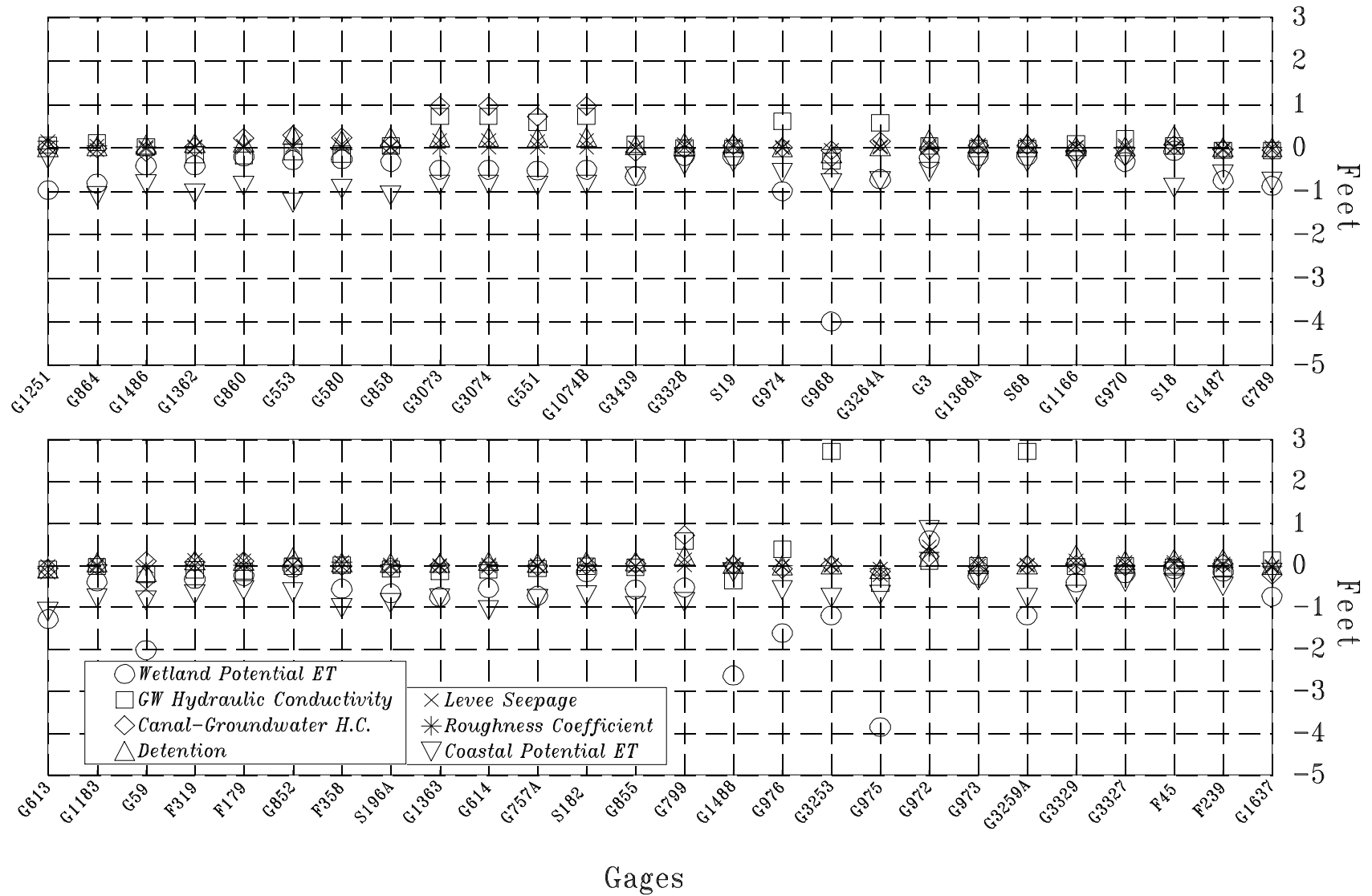


Figure 7.2.3 Components of the Sensitivity Matrix for Lower East Coast Service Area 3

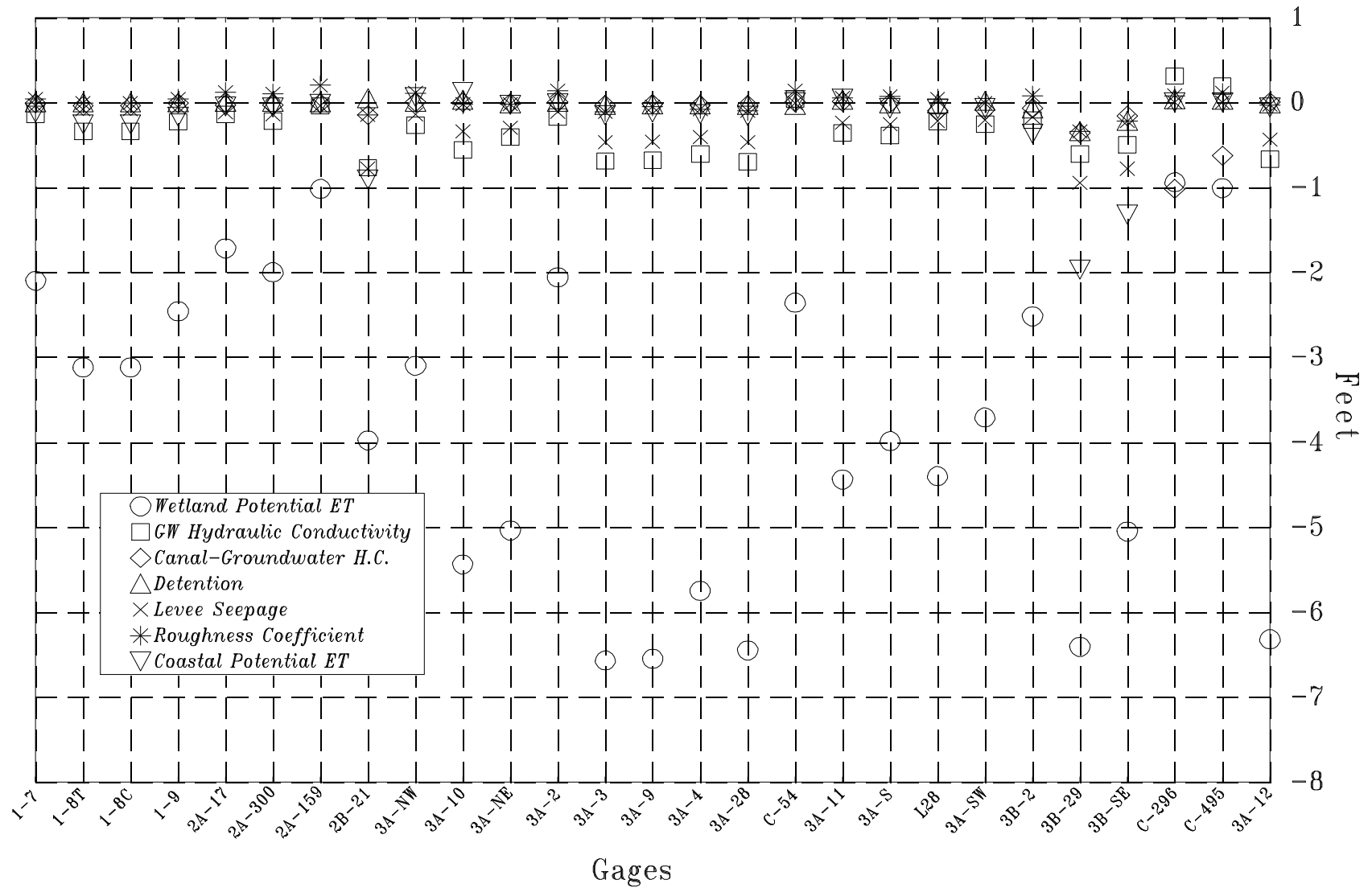


Figure 7.2.4 Components of the Sensitivity Matrix for Water Conservation Areas

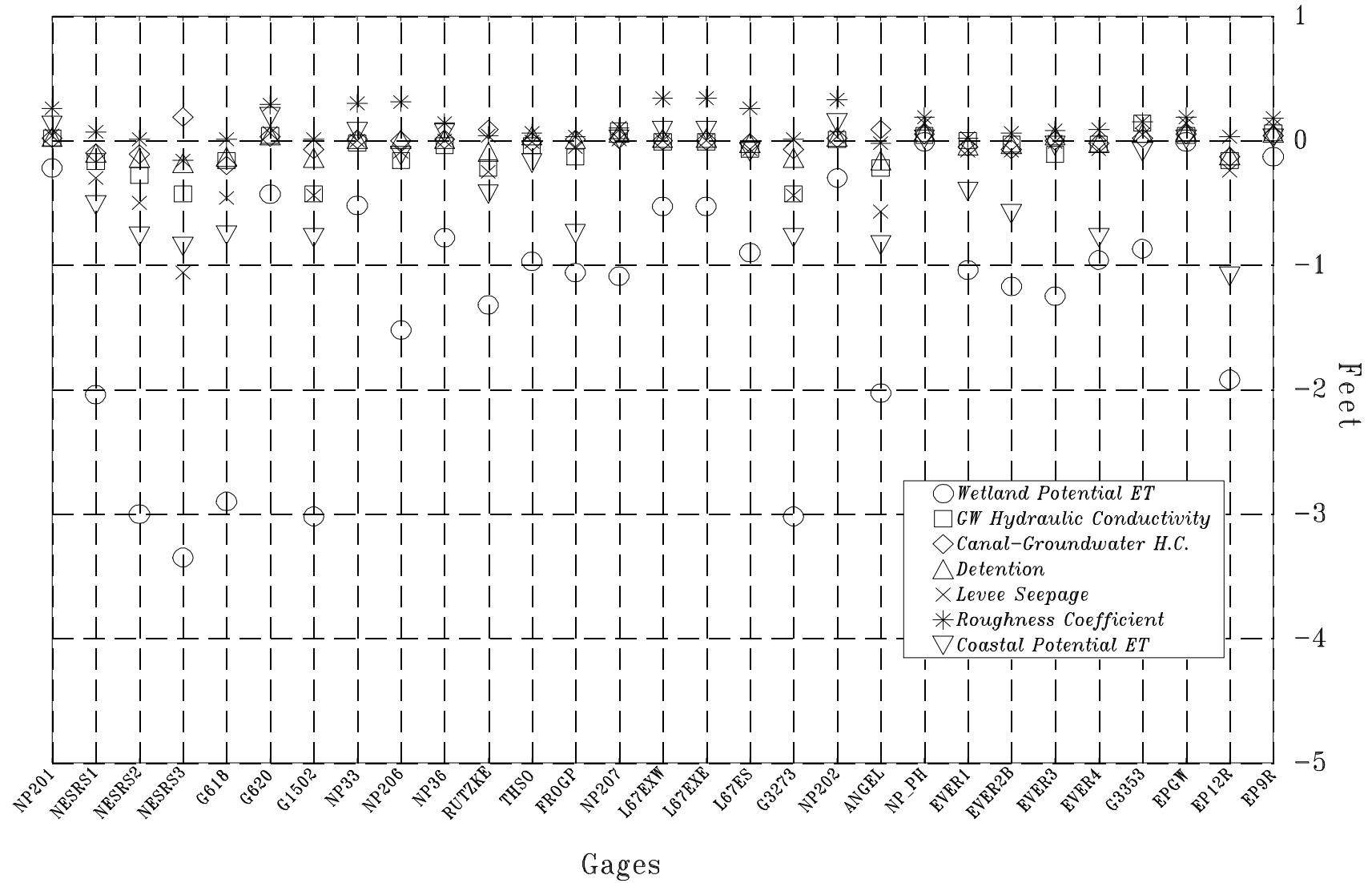


Figure 7.2.5 Components of the Sensitivity Matrix for Everglades National Park

Figs. 7.2.6 and 7.2.7 show the components of the sensitivity matrix for canal water levels and coastal outflows within the model domain. The following statements can be used to summarize the sensitivity analysis for these two types of model output (Trimble, 1995a):

1. Canal water levels and coastal outflows are most sensitive to coastal PET rates.
2. Coastal outflows from Dade County exhibit high sensitivity to canal-groundwater hydraulic conductivity.
3. Coastal PET and wetland PET equally influences simulated coastal outflows from Dade county.
4. Coastal flows in Broward and Palm Beach counties are less sensitive to wetland PET.

A product of the SVD method is the parameter resolution matrix which is a measure of the independence of parameters used in a model. For the SFWMM, the resolution matrix is well resolved, implying that each parameter is uniquely determined and thus, should be treated separately as far as its influence in determining model output sensitivity and uncertainty. In other words, these parameters affect model output independently.

Another useful information that can be derived from the SVD method is the correlation matrix for the model as shown in Table 7.2.1. This matrix shows that there is, in general, only modest correlation between model input parameters. The range of values do not indicate positive or negative correlation. They range from 0.0 for no correlation and 1.0 for perfect correlation. Detention depth and coastal PET are significantly correlated. If the detention depth is increased a corresponding increase in coastal PET would be necessary to prevent build-up of water, and thus maintain a valid calibration, at coastal areas.

Table 7.2.1 Parameter Correlation Matrix

	WLET ¹	GWHC ²	CHHC ³	DET ⁴	SEEP ⁵	SRC ⁶	CPET ⁷
WLET ¹	1.00	0.09	0.00	0.00	0.48	0.00	0.02
GWHC ²	0.09	1.00	0.10	0.02	0.01	0.07	0.02
CHHC ³	0.00	0.10	1.00	0.01	0.05	0.12	0.12
DET ⁴	0.00	0.02	0.01	1.00	0.10	0.08	0.44
SEEP ⁵	0.48	0.01	0.05	0.10	1.00	0.00	0.05
SRC ⁶	0.00	0.07	0.12	0.08	0.00	1.00	0.10
CPET ⁷	0.02	0.02	0.12	0.44	0.05	0.10	1.00

1 Wetland Potential Evapotranspiration Parameter

2 Groundwater Hydraulic Conductivity Parameter

3 Canal-Groundwater Hydraulic Conductivity Parameter

4 Detention Parameter

5 Seepage Parameter

6 Surface Roughness Parameter

7 Coastal Potential Evapotranspiration Parameter

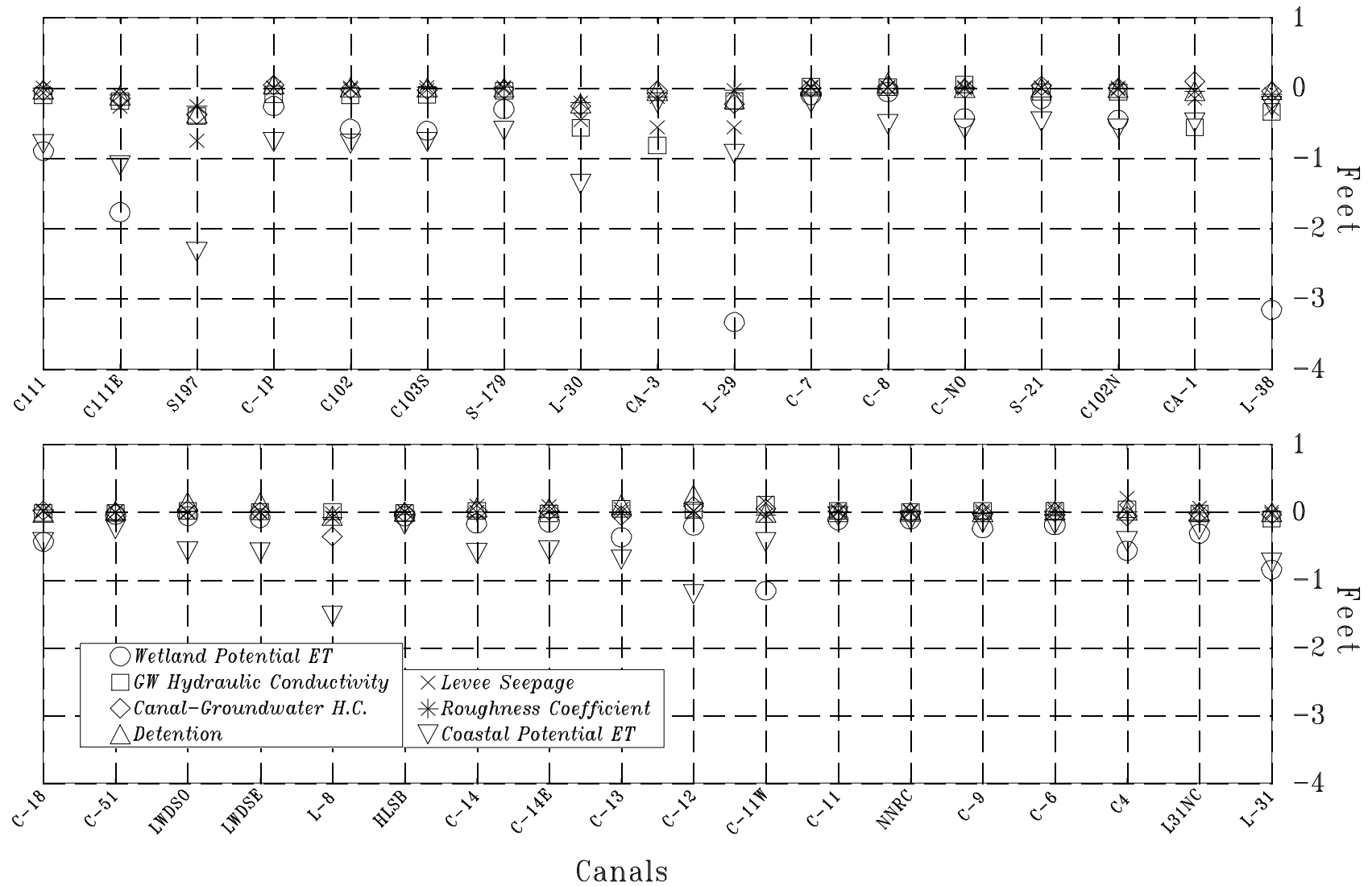


Figure 7.2.6 Components of the Sensitivity Matrix for Canals

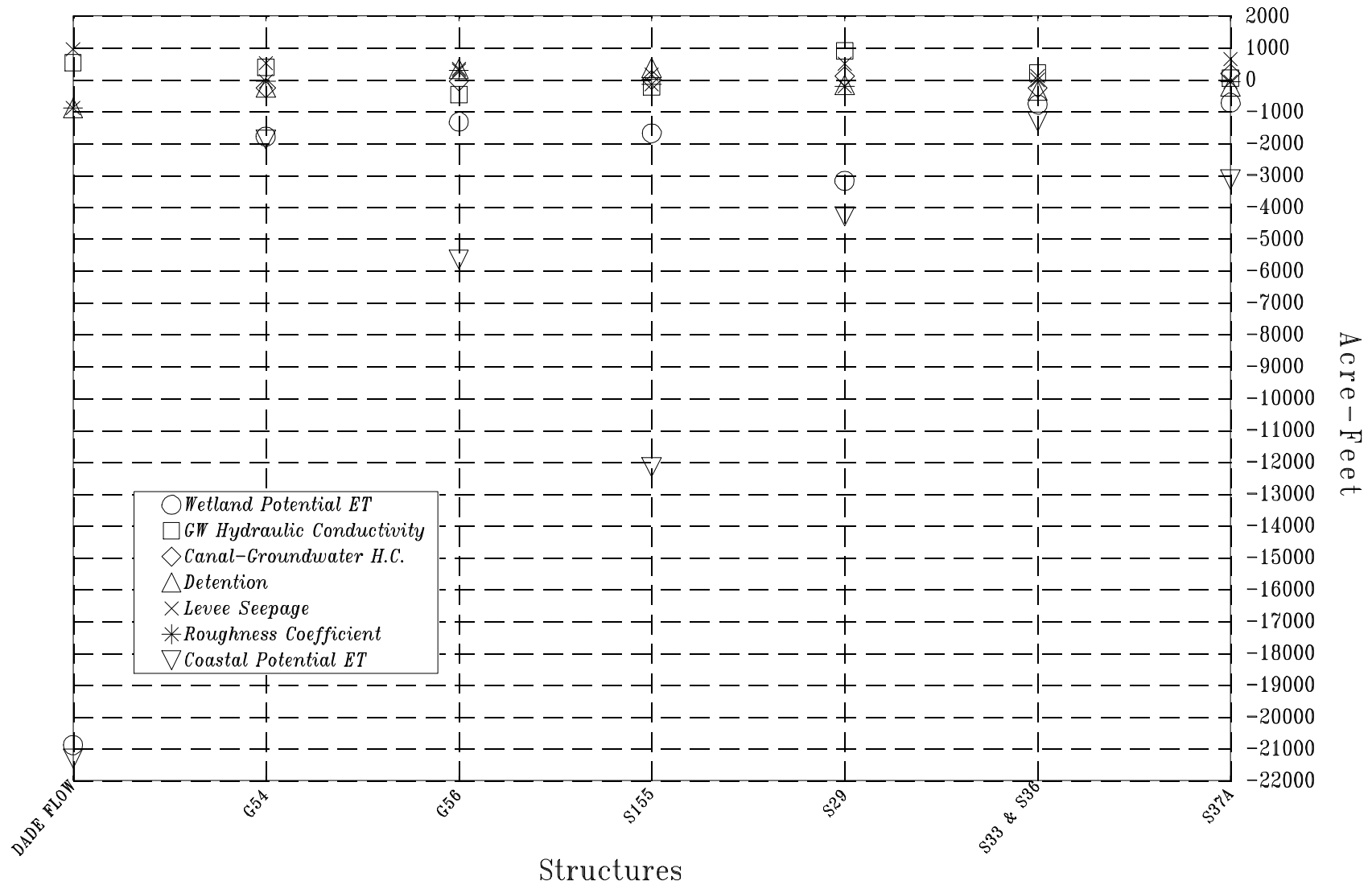


Figure 7.2.7 Components of the Sensitivity Matrix for Coastal Flows